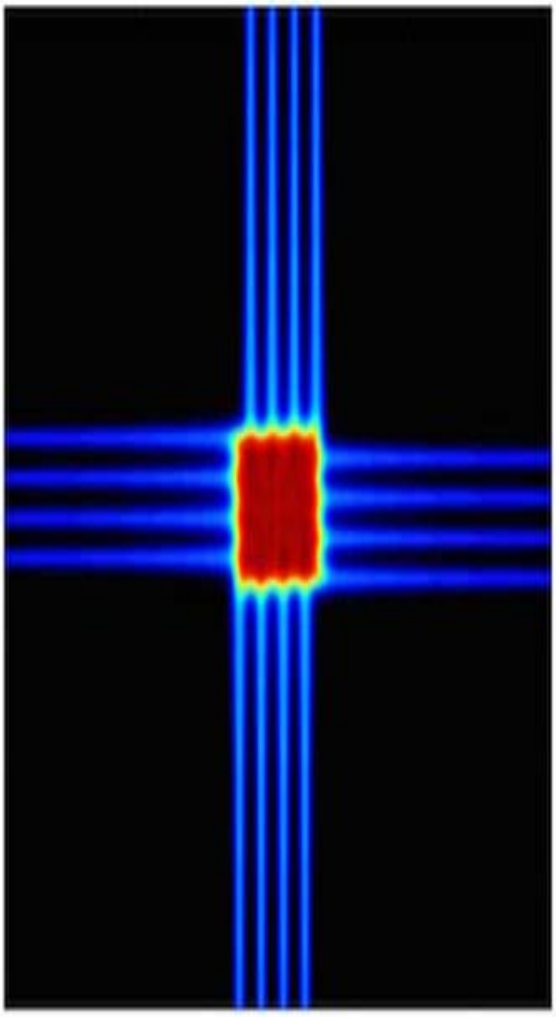

Conclusion: Proton-beam grids with 3 mm beam elements produce dose distributions in water for which the grid pattern is preserved down to large depths. PBGT could be carried out at proton therapy centers, equipped with spot-scanning possibilities, using existing tools. However, smaller beams than those currently available could be advantageous for biological reasons. With PBGT, it is also possible to create a more uniform target dose than what has been possible to produce with photon-beam grids. We anticipate that PBGT could be a useful technique to reduce both short- and long-term side effects after radiotherapy.

OC-0547

Towards Portal Dosimetry for the MR-linac: back-projection algorithm in the presence of MRI scanner

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Purpose or Objective: Currently, various MR-guided radiotherapy systems are being developed and clinically implemented. For conventional radiotherapy, Electronic Portal Imaging Devices (EPIDs) are frequently used for in vivo dose verification. The high complexity of online treatment adaptation makes independent dosimetric verification in the Elekta MR-linac combination indispensable. One of the challenges for MR-linac portal dosimetry is the presence of the MRI housing between the patient and the EPID.
The purpose of this study was to adapt our previously developed back-projection algorithm for the presence of the MRI scanner.

Material and Methods: Three steps have been added to our current EPID dosimetry back-projection model to account for the presence of the MRI scanner: i) subtraction of scatter from the MRI to the EPID, ii) correction for the MRI attenuation, iii) compensation for changes in the beam spectrum. The calibration of the algorithm needs a set of commissioning data (from EPID and ionization chamber, both with and without the MRI) to determine the parameters for the back-projection method.
An aluminum block of 12 cm thickness at 15 cm distance from the EPID was used to approximate the effects of the MRI scanner. Measurements were performed using a 6MV photon beam of a conventional SL20i linear accelerator (Elekta AB, Stockholm, Sweden) at 0° gantry.
58 IMRT fields of 11 plans (H&N, lung, prostate and rectum) were delivered to a 20 cm polystyrene slab phantom and portal images were acquired with the aluminum plate in place. For independent comparison with our conventional method the same fields were delivered without the aluminum plate. The EPID images were converted to dose, corrected for the presence of the aluminum plate, back-projected into the phantom and compared to the planned dose distribution using a 2-D gamma evaluation (3%, 3 mm).

Results: The γ_mean averaged over the 58 IMRT fields was 0.39±0.11, the γ_1% was 1.05±0.30 and the %_γ≤1 was 95.7±5.3. The dose difference at the isocenter was -0.7±2.2 cGy. These results are in close agreement with the performance of our algorithm for the conventional linac setup (Table 1).

	γ_{mean}	$\gamma_{1\%}$	$\%\gamma_{\leq 1}$	ΔDose iso (cGy)
Conventional	0.35 ± 0.10	0.94 ± 0.18	98.1 ± 3.8	-1.9 ± 2.3
MR/aluminum	0.39 ± 0.11	1.05 ± 0.30	95.7 ± 5.3	-0.7 ± 2.2

Table 1: γ results (3%,3mm) averaged over the 58 IMRT fields. Our conventional back-projection method was used to back-project portal images acquired without the aluminum plate (top) and our adapted method was used to correct and back-project portal images acquired with the aluminum in place (bottom).

Conclusion: Our EPID dosimetry back projection algorithm was successfully adapted for the presence of an attenuating medium between phantom (or patient) and EPID. Experiments using a 12 cm aluminum plate (approximating the MR-linac geometry) showed excellent agreement between planned and EPID reconstructed dose distributions. This result is an essential step towards an accurate, independent, and potentially fast field-by-field IMRT portal dosimetry based verification tool for the MR-linac.
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Hyperthermia treatment planning in the pelvis using thermophysical fluid modelling of the bladder

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Purpose or Objective: Hyperthermia is a (neo)adjuvant treatment modality that increases the effectiveness of radiotherapy or chemotherapy by heating the tumour area to 41–43 °C. Loco-regional hyperthermia is delivered using phased array systems with individually controlled antennae. Hyperthermia treatment planning is necessary to determine the phase and amplitude settings for the individual antennae that result in the optimal temperature distribution. Current treatment planning systems are accurate for solid tissues but ignore the specific properties of the urinary bladder and its contents, which limits their accuracy in the pelvic region. This may have clinical implications for such treatment sites as the rectum, the cervix uteri, and the bladder itself.